Exploration Systems Mission Directorate Risk Management

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Realizing the Future
Earth, Moon, Mars, and Beyond

Foster and sustain the exploration culture across generations

- Open new frontiers
- Continuing and inspiring
- A constant impetus to educate and train

Identify, develop, and apply advanced technologies to…

- Enable exploration and discovery
- Allow the public to actively participate in the journey
- Translate the benefits of these technologies to improve life on Earth

Harness the brain power

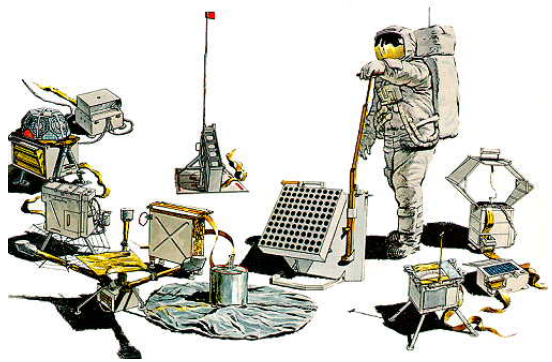
- Engage the nation's science and engineering assets
- Motivate successive generations of students to pursue science, math, engineering and technology
- Create the tools to facilitate broad national technical participation

International Cooperation

- Promote common objectives and cooperative/complementary efforts for space exploration
- Utilize international capabilities to help close capability gaps and develop breakthrough technologies

Exploration Systems Implementation
Key Objectives & Milestones

- **Objectives**
  - Implement a sustained and affordable human and robotic program
  - Extend human presence across the solar system and beyond
  - Develop supporting innovative technologies, knowledge, and infrastructures
  - Promote international and commercial participation in exploration
- **Major Milestones**
  - 2008: Initial flight test of CEV
  - 2008: Launch first lunar robotic orbiter
  - 2009-2010: Robotic mission to lunar surface
  - 2011: First uncrewed CEV flight
  - 2014: First crewed CEV flight
  - 2012-2015: Jupiter Icy Moons Orbiter (JIMO)/Prometheus
  - 2015-2020: First human mission to the Moon



Vision Requires System-of-Systems Integration

Cross-Agency Coordination & Integration

Transit and Launch Systems

Crew Transport

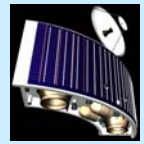
Launch

Crew Support

The Human: an Essential Element of the System of Systems

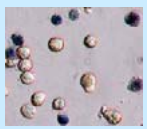
Surface and Orbital Systems

Landing Systems



Comm/Nav

Surface Mobility



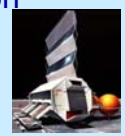
Biomedical Countermeasures and Limits

Resource Identification and Characterization

Supporting Research

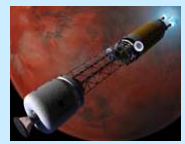
Long-Duration Habitation

Pre-Positioned Propellants



Surface Power and Resource Utilization

Technology Options



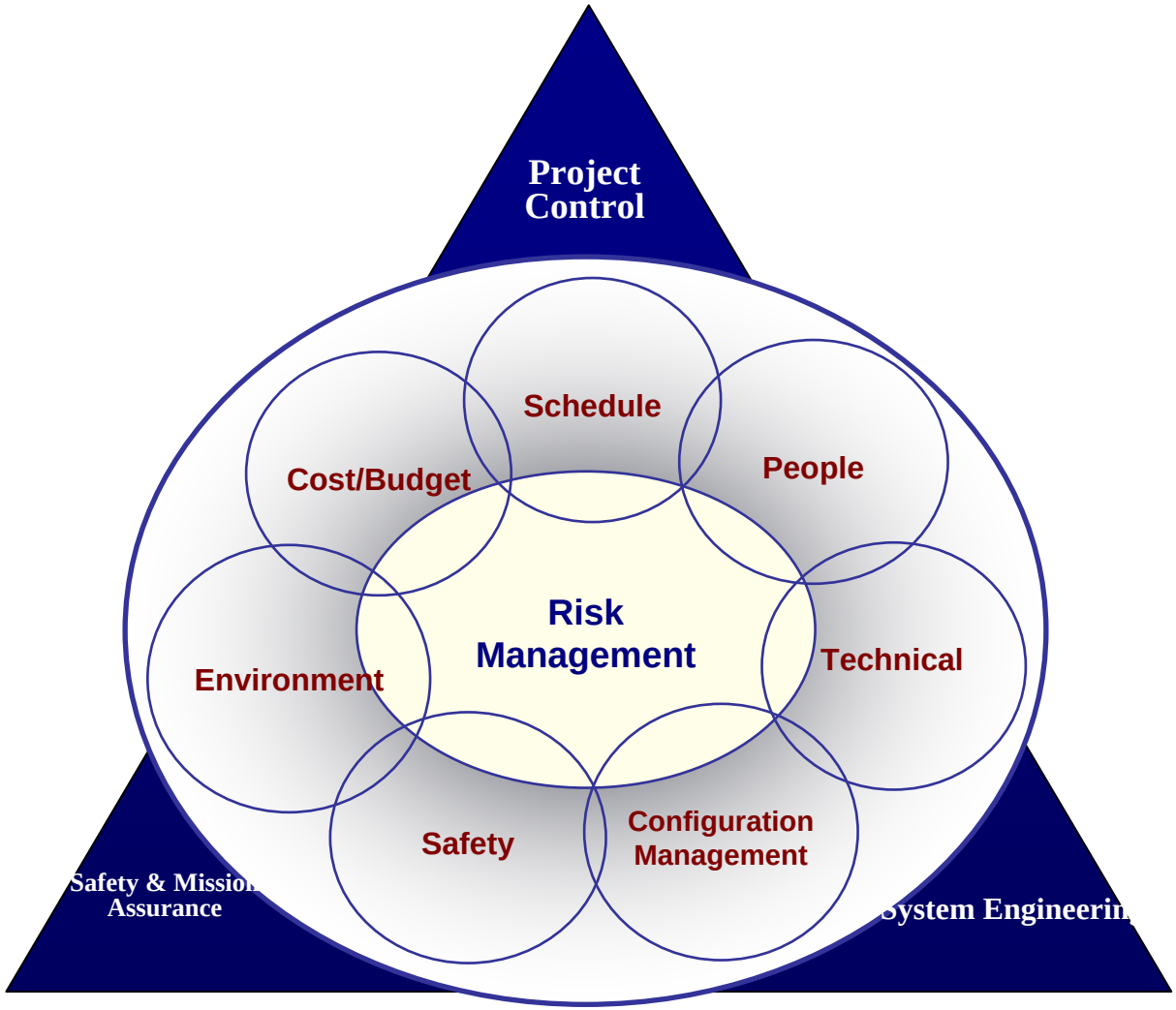
Mars Candidates

Telescope Candidates

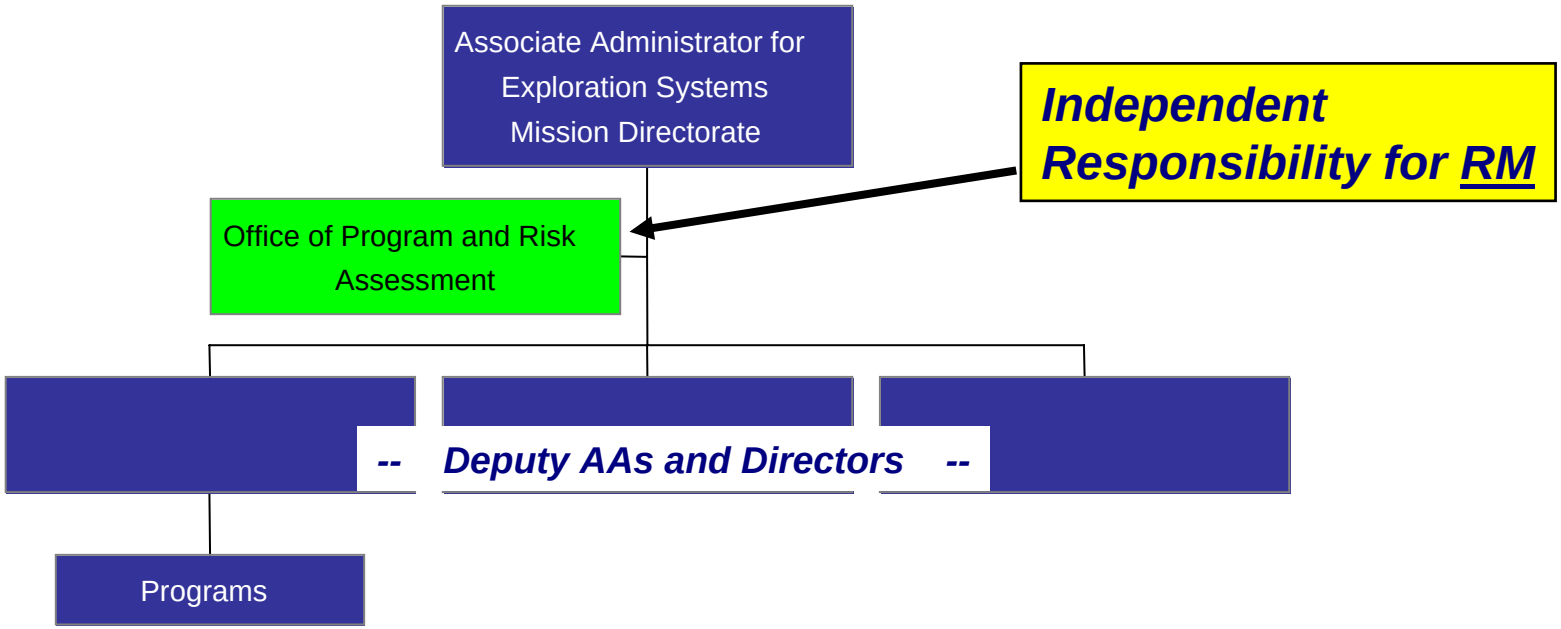
Outer Moons Candidates

Commonality/Evolvability For Future Missions

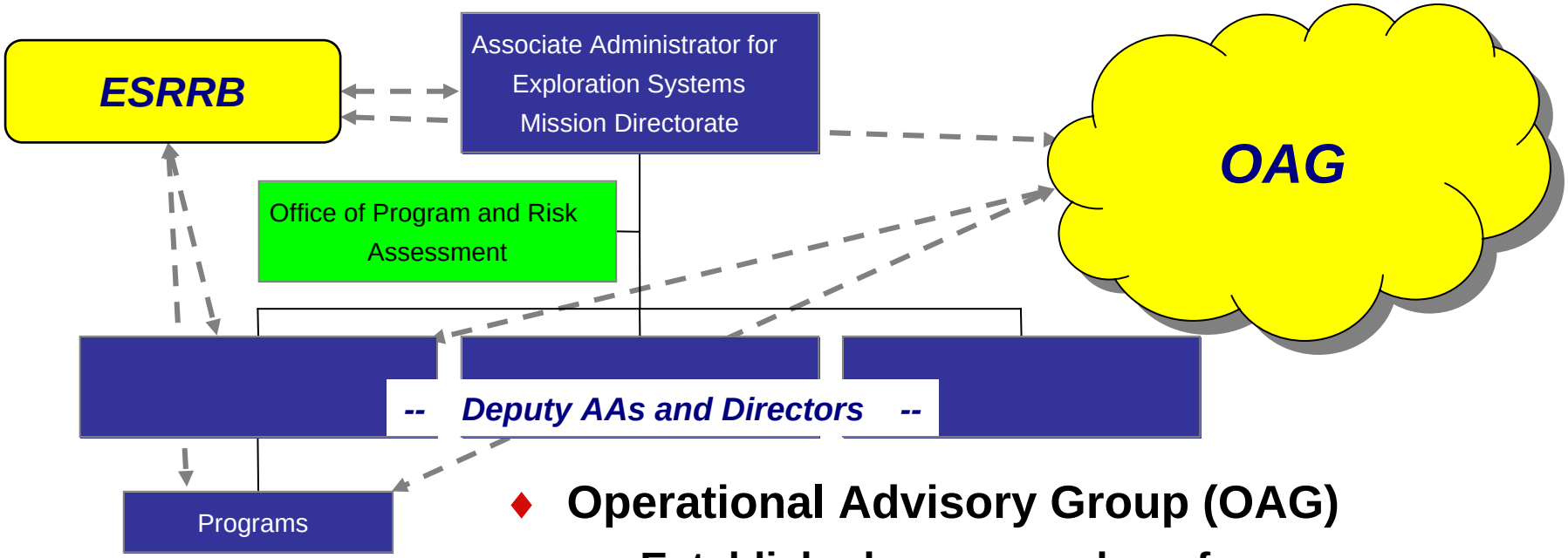
Risk Management Coverage



Organization



Organization: External Relationships



- **Operational Advisory Group (OAG)**
  - **Established, core members from Operational Organizations and users**
  - **Provide inputs and independent perspectives**
- **Exploration Systems Requirements Review Board (ESRRB)**
  - **Wide, senior membership--includes S&MA officer**
  - **Review and approve ESMD requirements**

Requirements Formulation Overview

Multi-Center Analysis Teams

Broad Trades

Architectural Variants (Examples)

- Moon Short Stay
- Moon Long Stay
- Global Access
- Single Site
- Multiple Sites
- High-Earth Orbit
- Libration Points
- Mars Orbit
- Mars Short Stay
- Mars Long Stay

Technology Infusion (Examples)

- Chemical
- Nuclear
- Fuel Cells
- Solar
- ECLSS Closure
- Open Loop
- Storables
- Cryogenics
- Thermal Protection
- Breakthroughs

Operational Concepts (Examples)

- Pre-Deploy
- All-Up
- Lunar Orbit
- Libration Point
- Tandem
- Convoy
- Surface Stay
- Abort Options
- Staging Altitude
- Staging Strategy

Safety | **Effectiveness** | **Extensibility** | **Affordability**

Focused Trades

Architectural Variants (Examples)

- Launch Constraints
- Return Strategy
- Staging Altitude
- Plane Change
- Tandem / Convoy
- Surface Strategy

Technologies & Sensitivities (Examples)

- Propellants
- Power
- Crew Size
- Surface stay
- Payload Down
- Payload Returned
- Launch Frequency
- Radiation Shielding

Mission Capture (Examples)

- Lunar Short Stay
- Lunar Long Stay
- Polar / Equatorial
- Global Access
- Libration
- Mars Staging
- Mars Return
- ISS (TBD)

Strategy-to-Task-to-Technology (STT) Decision Panel—(OAG)

Concept of Operations and Draft Requirements

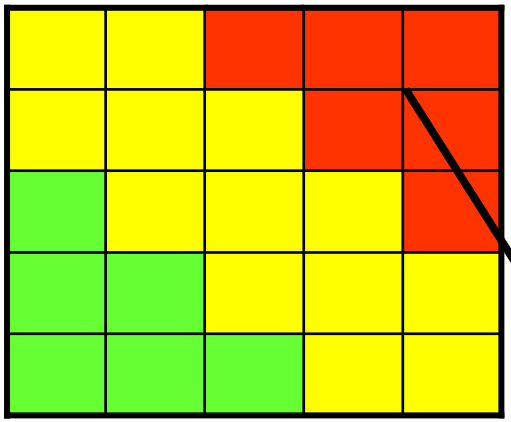
Safety-related Measures of Performance

- **Risks**
- **Hazards**
- **Aborts**
- **Redundancy**
- **Reliability**
- **Contingencies**

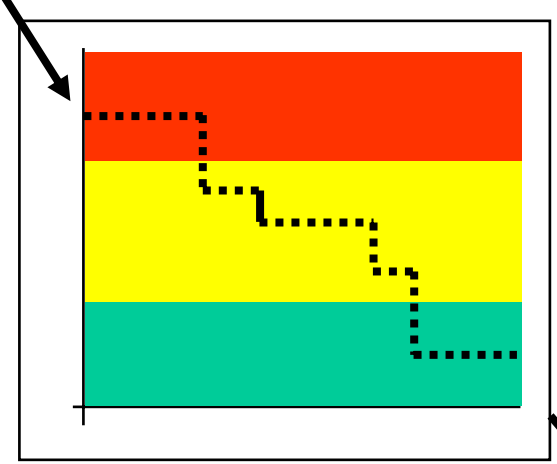
RM Processes

- **ESMD Program Management Handbook (PMH)**
  - **Contains overarching guidelines and processes - RM is key**
  - **Drawing from best practices**
    - NASA HQ, NASA Centers, DoD, Industry…
  - **One NASA - input and coordination from across NASA**
  - **RM is an integral part of ESMD management rigor**
  - **Currently in development—planned release early 2005**

Risk Management Approach

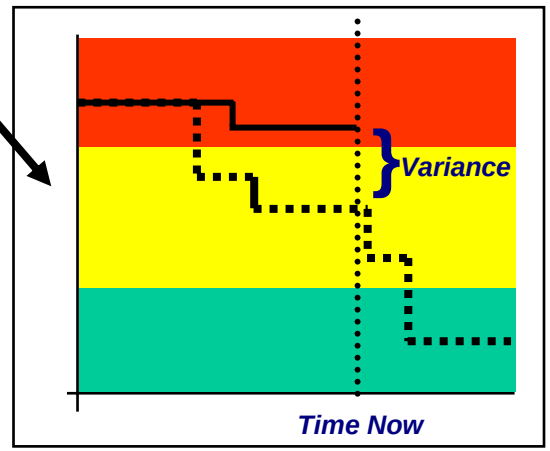


Risk Identification and Assessment



Baseline Requirement for Risk Retirement

Retirement Status, Variance Analysis, and Corrective Action



Ongoing Activities: Constellation Systems

- Risk-Based Acquisition Management (RBAM) training completed Oct 2004
- Initial acquisition risk lists and mitigation plans have been developed and are being migrated to the ESMD RM IT tool
- ESMD has highlighted risk as a core acquisition concern
  - Lessons-learned from Orbital Space Plane and Next Generation Launch Technology programs
  - Items reviewed and moved to program risk watch lists

Tools

- **Active Risk Manager – Risk Management**
- **Windchill – Document, Configuration Management, Process, etc.**
- **Winsight – Earned Value Management**
- **DOORS – Requirements Management**

Summary

- Program and Risk Assessment Office Established
- We are developing process definitions for application across the entire portfolio
  - Integrated within overall program management framework
  - Leveraging “best practices”
- We have already begun implementing RM practices in our programs
- Future focus areas:
  - Tightening process definitions
  - Establishing management rigor